PATENT
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Lee et al. §
§
Serial No.: 09/401,132 § Group Art Unit: 2613
§
Confirmation No.: 4242 § Examiner: Bugg, George A.
§
Filed: September 22, 1999 §
§
For: Apparatus and Method for Object Based Rate Control in a Coding System §
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Dear Sir:

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APPEAL BRIEF

Appellants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 2613 dated July 22, 2003, finally rejecting claims 22-30 and 3238. Three (3) copies of this brief are submitted for use by the Board.

Real Party in Interest

The present application has been assigned to Sarnoff Corporation of Princeton, New Jersey.

Related Appeals and Interferences

Appellants assert that no other appeals or interferences are known to the Appellants, the Appellants' legal representative, or assignee that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 22-30 and 32-38 are pending in the application. Claims 1-21 were presented in the application as originally filed on September 22, 1999. A Preliminary Amendment also filed on September 22, 1999, in which original claims 1-21 were cancelled and new claims 22-38 were added. In a response to a second non-Final Office Action on April 16, 2003, claim 31 was cancelled and claim 29 was amended. Claims 22-30 and 32-38 stand rejected in view of a single reference as discussed below. The Appellants appeal the rejection of claims 22-30 and 32-38 based on the cited reference. The pending claims are provided in the attached Appendix.

Status of Responses

A preliminary amendment was filed on September 22, 1999. The preliminary amendment cancelled originally filed claims 1-21 and added new claims 22-38.

A first response was filed on May 14, 2002 in response to the Examiner's first non-final Office Action mailed on February 14, 2002 (paper no. 7). No claims were impacted by the response. The first response included arguments directed at traversing the Examiner's 35 U.S.C. §102 rejections.

A second response was filed on April 16, 2003 in response to the Examiner's second non-final Office Action mailed on January 16, 2003 (paper no. 11). The second response included canceling claim 31 and amending claim 29. The second response included arguments directed at traversing the Examiner's 35 U.S.C. §102 rejection and a judicially created Doctrine of Double Patenting rejection.

The Examiner responded to Appellants' April 16, 2003 response in a Final Office Action dated July 2, 2003 (paper no. 13). In the Final Office Action, the Examiner did not find the Appellants' arguments persuasive, and maintained the 35 U.S.C. §102 rejections in view of the same reference cited in the second non-final Office Action.

A response to the Final Office Action was filed, on September 6, 2003, which included additional arguments directed at traversing the Examiner's 35 U.S.C. §102 rejections. No claims were impacted by the response.

The Examiner responded to Appellants' September 6, 2003 response in an Advisory Action dated September 24, 2003 (paper no. 15). In the Advisory Action, the Examiner noted that the amendment would be entered for purposes of Appeal, however the amended features are disclosed in the reference, and the Appellants' arguments against the 35 U.S.C. §102 rejections are not persuasive.

Summary of Invention

The present invention overcomes the deficiencies and limitations of the prior art with a method and apparatus for allocating bits to encode each frame of an image sequence, where each frame includes at least one object. Referring to FIG. 2, a flowchart is shown illustrating a method 200 for deriving and allocating bits for an image based on objects within the image. More specifically, method 200 starts at step 205 and proceeds to step 210, where a target frame bit rate (T_{frame}) is determined for a current frame. In one embodiment, the target frame bit rate is determined using a complexity measure that is recursively adjusted through the use of a polynomial regression process, as illustrated by method 300 of FIG. 3 (see Appellants' specification, page 10 line 31 to page 11, line 3).

Referring to FIG. 3, the target frame bit rate (T_{frame}) is computed based on the bits available and the last encoded frame bits. If the last frame is complex and uses many bits, it leads to the premise that more bits should be assigned to the current frame. However, this increased allocation will diminish the available number of bits for encoding the remaining frames, thereby limiting the increased allocation to this frame. A weighted average reflects a compromise of these two factors (see Appellants' specification, page 11 lines 19-26).

Specifically, method 300 then adjusts the calculated target frame bit rate (T_{frame}) by the current buffer fullness. Accordingly, if the buffer is more than half full, the adjusted target bit rate (T'_{frame}) is decreased. Conversely, if the buffer is less than half full, the adjusted target bit rate (T'_{frame}) is increased. If the buffer is exactly at half, no

adjustment is necessary. In step 330, method 300 then optionally verifies that a lower bound of target frame bit rate is maintained (see Appellants' specification, page 11 line 27 to page 12 line 11).

Returning to FIG. 2, once the target frame bit rate (T_{frame}) is determined, method 200 then determines one or more target object bit rates for the objects within the current image as illustrated in FIG. 4 below. Method 200 then ends in step 230.

FIG. 4 illustrates a flowchart of a method 400 for determining one or more target object bit rates for the objects within the current image. The method starts in step 405 and proceeds to step 410, where target object bit rate, V_i, is determined for each object i (i= 1, 2, 3...) (see Appellants' specification, page 13 lines 1-8).

In step 420, method 400 queries whether V_i is large enough to convey the shape information of object i. Namely, the target object bits V_i are used to code three sets of information: 1) syntax information (e.g., header information), 2) motion information (motion vectors) for object i and 3) shape information that defines the shape of the object i within the image. At step 423, the bits used to code shape information are maintained or decreased in an instance where the target object bit rate, V_i, is determined to be insufficient to convey shape information. Otherwise, at step 425, the bits used to code shape information are maintained or increased in an instance where the target object bit rate, V_i, is determined to be sufficient to convey shape information (see Appellants' specification, page 14, line 1 to page 16 line 24).

At step 430, V_i is adjusted in accordance with the current state of the buffer, i.e., the fullness of the buffer. At this step, method 400 has completed the task of computing a target object bit rate V_i for each object in the image.

Once V_i for each object in the image is determined, the target object bit rate V_i can be used to effect other coding parameters such as determining a quantizer scale for each object as discussed below. Alternatively, other coding parameters such as allocation of computing resources can be implemented. Namely, if it is determined that a particular object has a high V_i, then it is possible to allocate more processing power, e.g., dedicating more processors in a multiple processors coding system in coding a particular object.

Returning to FIG. 4, in step 440, method 400 calculates a quantization scale Q_i for each object i and then encodes the object i in step 450 using the quantization scale Q_i. Method 400 then ends in step 460 (see Appellants' specification, page 17 lines 15-29).

For the convenience of the Board of Patent Appeals and Interferences, Appellants' claim 22 (one of the broadest independent claims) is presented below in claim format with elements read on FIGS. 2-4 of the drawings, as suggested in MPEP 1206. Claim 22 positively recites (with reference numerals added):

> 22. A method (200) for allocating bits to encode each frame of an image sequence, each of said frame having at least one object, said method comprising the steps of:
>
> (a) determining (210, 305-340) a target frame bit rate for the frame ; and
>
> (b) allocating (220, 405-460) said target frame bit rate among the at least one object, wherein said allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object.

Issues Presented

Whether claims 22-30 and 32-38 are patentable under 35 U.S.C. §102 over the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis").

Grouping of Claims

The rejected pending claims 21-30 and 32-38 have been grouped together in the rejection. Appellants urge that each of the rejected claims stands on its own recitation, the claims being considered to be separately patentable for reasons set forth below in more detail.

The References

The following references are relied on by the Examiner:

Author	Publication Title or Reference Number	Publication Date
Eleftheriadis et al.	United States Patent: 6,055,330	April 25, 2000

Brief Description of the References

United States Patent No. 6,055,330 to Eleftheriadis et al. (hereinafter "Eleftheriadis") teaches identifying one or more separate objects within depth information, which corresponds to a field or frame of video information (see Eleftheriadis, Abstract). The main focus of Eleftheriadis is to provide an object segmentation circuit for receiving depth information which corresponds to a frame of video information and for identifying one or more separate objects within the frame of video information. An object map generation circuit converts the depth information into an object map in order to associate each pixel within the frame of the video information with one or more regions of varying perceptual importance within the frame (see Eleftheriadis, column 3, lines 54-64).

Referring to FIG. 3, rate control may be performed by placing a buffer 320 at the output 310 of the variable bit rate (VBR) encoder 200. In turn, the buffer 320 outputs compressed data at a constant rate which is dependant on the bandwidth of the channel which is accepting data from the buffer. The buffer's occupancy B_{max} and other, possibly signal dependent, parameters are then taken into account by a rate controller 340 in order to decide the quantizer step size in quantizer 251 to be used for subsequent macroblocks so that buffer overflow or underflow does not occur. The term rate control is used without discriminating whether or not a CBR or VBR encoder is used (see Eleftheriadis, column 8, lines 17-47).

For CBR coding, the rate controller must additionally regulate quantizer selection so that the output buffer neither overflows nor underflows. Each object is associated with a particular target average bit rate R_i, where i= 1, ..., n-1, except for the background (object n, i.e., R_n). In order to maintain the given total average rate R necessary to prevent buffer overflow, the background rate is determined according to the formula $\sum_{i=0}^{n} a_i R_i = R$, where a_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i. By definition, $\sum_{i=0}^{n} a_i = 1$. While it is possible that the background R_n is negative, this simply has the effect of assigning as course quantization as possible to the background, and may result in less average bits per

second per object that the target bit rates R_i indicate (see Eleftheriadis, column 11, line 53 to column 12, line 19).

ARGUMENTS

THE ISSUES UNDER 35 U.S.C. §102

It is submitted that a reasonable interpretation of the references as proposed by the Examiner in the second non-final office action, as well as the Final Office Action would not have resulted in the invention recited in the Appellants' claims.

A. 35 U.S.C. §102 – Claims 22 and 32

The Examiner has rejected claims 22 and 32 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, the Examiner alleges that Eleftheriadis discloses:

> Objects associated with, assigned, or allocated a target object bit rate, based on a target frame bit rate. Specifically, R is the frame bit rate or target bit rate, R_i is a target average bit rate for each object, a_i is the amount of the total frame rate R that is allocated to the object while R_n is the amount of the total frame rate R that is allocated to the background.
>
> The Examiner further alleges that the allocation target frame bit rate, in accordance to a target object bit rate, for a at least one object, is also disclosed in Column 12, Equation 4 (i.e., $\sum_{i=0}^{n} a_i R_i = R$). As can be seen, part of the target frame bit rate is allocated or distributed as target object bit rate, while the remainder is allocated or distributed as background target bit rate, the sum of the two being equal to R (target frame bit rate).
>
> Column 15, lines 19-35 disclose multiple functions of Eleftheriadis' invention being implemented through software and hardware, which is equivalent to instructions being stored on a computer readable medium for carrying out method of claim 22. In addition, this section also teaches that the target object bit rate is adjusted depending on buffer fullness.

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "determining a target frame bit rate for the frame" and "allocating said target frame bit rate among the at least one object, wherein said

allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object."

Specifically, Appellants' independent claims 22 and 32 recite:

> 22. "A method (200) for allocating bits to encode each frame of an image sequence, each of said frame having at least one object, said method comprising the steps of:
> (a) determining (210, 305-340) a target frame bit rate for the frame ; and
> (b) allocating (220, 405-460) said target frame bit rate among the at least one object, wherein said allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." (emphasis added).

> 32. A computer-readable medium having stored thereon a plurality of instructions, the plurality of instructions including instructions which, when executed by a processor, cause the processor to perform the steps comprising of:
> (a) determining (210, 305-340) a target frame bit rate for the frame; and
> (b) allocating (220, 405-460) said target frame bit rate among the at least one object, wherein said allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." (emphasis added).

The Appellants' invention teaches a method for allocating bits to encode each frame of an image sequence, where each frame has at least one object. Namely, Appellants' invention teaches determining a target frame bit rate for the frame, and then allocating the target frame bit rate in accordance with a target object bit rate for the at least one object.

Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim" (Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added). The Eleftheriadis reference fails to disclose each and every element of the claimed invention, as arranged in the claim.

By contrast, Eleftheriadis discloses a method and apparatus for performing image compression and segmentation by using 3-D depth information. Namely,

Eleftheriadis' device is able to exploit depth information to assist in the compression and segmentation of images. (See Eleftheriadis, Abstract).

In particular, the Eleftheriadis reference merely discloses "in accordance with that technique, each object is associated with a particular target average bit rate R_i, i=1, . . . , n-1, except for the background (object n). In order to maintain the given total average rate R necessary to prevent buffer overflow, the **background rate** is determined according to the formula:

$\sum_{i=0}^{n} \alpha_i R_i = R$ where α_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i." (Emphasis added, See, Eleftheriadis, Column 11, line 67 to Column 12, line 10)

Thus, Eleftheriadis is simply disclosing an allocation approach where the average rate R necessary to prevent buffer overflow is used to compute the **background rate**.

Eleftheriadis also defines "R is the average output bit rate to be maintained by the buffer 1020". (See Eleftheriadis, Column 13, lines 31-32). In other words, R represents a measure of the physical buffer "fullness" and it is **not** a "target frame bit rate" as claimed by the Appellants. Namely, Eleftheriadis' teaching of using the average output bit rate of a physical buffer to compute a background rate would not anticipate Appellants' invention that recites the novel concept of computing a target object bit rate for each object and then allocating a target frame bit rate among the objects in accordance with their computed target object bit rates.

Another clear indication is that Eleftheriadis states that "referring again to FIG. 10, the rates R_i are used in a buffer regulation process that uses a technique of buffer rate and buffer size modulation" (See Eleftheriadis, Column 12, lines 40-42). It is absolutely clear that the object rate of Eleftheriadis is premised on the buffer fullness and not based on a target frame rate.

In the Final Office Action, the Examiner reasoned that "any bit rate utilized to maintain buffer fullness, and prevent underflow can be considered a target bit rate as claimed by the Appellants". Appellants respectfully disagree.

Appellants specifically recite "a target **frame** bit rate" and not a general "target bit rate" as alleged by the Examiner. Generally, the buffer fullness is intended to operate with a transmission channel with a constant transmission rate. Thus, it is generally

necessary to monitor the fullness of the buffer to avoid overflow and underflow conditions. Aside from this general understanding, it is improper to then simply extrapolate the teaching of the buffer fullness to the determination of a target frame bit rate. For example, if the buffer is too full, the encoder may simply drop a frame, change the coding mode of a frame, change the frame type, change the quantizer scale of a frame, change the quantizer scale of a slice, change the quantizer scale of a macroblock, change the block size, and so on. None of these possible solutions requires the determination of a target frame bit rate. The number of possible solutions is endless in responding to buffer fullness conditions and involves numerous image processing fields. Is the Examiner indicating that Eleftheriadis' simple teaching of monitoring buffer fullness now anticipates all possible inventions relating to rate control, motion estimation, motion compensation, mode decision, frame type selection, block size selection and so forth? The Examiner's interpretation is simply too broad.

Accordingly, the Appellants submit that R, as defined by Eleftheriadis, can not be interpreted to be a target frame rate as positively claimed by the Appellants. There is simply no support in Eleftheriadis for this interpretation. Additionally, Appellants claim a **target** frame bit rate. Namely, Appellants' invention computes a specific budget for each frame.

For example, in one embodiment, the Appellants have defined a target frame bit rate as being determined based on the bits available and the last encoded frame bits. If the last frame is complex and uses many bits, it leads to the premise that more bits should be assigned to the current frame. However, this increased allocation will diminish the available number of bits for encoding the remaining frames, thereby limiting the increased allocation to this frame. Accordingly, a weighted average reflects a compromise of these two factors, and the non-weighted target frame bit rate adjusted by the current buffer fullness (see Appellants' specification, page 11, lines 19-30).

Thus, the Appellants' target frame bit rate is clearly different from the Eleftheriadis reference teachings of a total average rate R. Thus, the Eleftheriadis reference is concerned with a total average rate R for the objects R_i, while the Appellants' invention provides a target frame bit rate, which is based on the bits available and the last encoded frame bits. Therefore, the Eleftheriadis reference fails to

teach each and every element in the claimed invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame."

Furthermore, the Eleftheriadis reference fails to teach a **target** object bit rate V_i. Again, Appellants' invention computes a specific bit budget for each object. In one embodiment, the Appellants' invention provides that the target object bit rate V_i is determined for each object i (i= 1,2, ...), where a computation is performed on the entire region or regions that define an "object" in the image to obtain an average pixel value for the object. More specifically, the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object. Next, the sum of all the absolute differences (SAD) of the pixels for the object is performed. Finally, the SAD is divided by the number of pixels in the object to produce a mean of the absolute difference pixel values (MAD) for the object. Thus, the target frame bits T_{frame} are distributed proportional to the square mean of the absolute differences (MAD) of an object (see Appellants' specification, page 13 lines 5-26).

By contrast, the Eleftheriadis reference discloses a particular target average bit rate R_i, without further defining what constitutes a target average bit rate. That is, Eleftheriadis is completely silent regarding this matter. By contrast, the Appellants have defined a target object bit rate V_i as a mean of the absolute difference pixel values (MAD) for the object. Therefore, the Eleftheriadis reference fails to teach each and every element in the claimed invention, as arranged in the claim.

As such, the Appellants submit that independent claims 22 and 32 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, claim 22 is a method claim and claim 32 is a computer readable medium claim. Furthermore, Appellants assert that these claims are different to the extent that claim 22 recites the present invention as a general method, whereas claim 32 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

B. 35 U.S.C. §102 – Claim 23 and 33

The Examiner has rejected claims 23 and 33 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claims 23 and 33 respectively depend from independent claims 22 and 32, and recite additional features thereof. The Eleftheriadis reference fails to teach claims 22 and 32 of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim. As such, Appellants respectfully submit that dependent claims 23 and 33 are also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that Eleftheriadis discloses:

> "the use of the sum of the absolute differences, between two VOP to obtain shape information, and further control the rate at which object information is processed. The mean absolute difference is an inherent manipulation of data obtained through the summing of the absolute differences."

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' " wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object."

Specifically, Appellants' claims 23 and 33 recite:

> 23. "The method of claim 22, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object." (emphasis added).

> 33. "The computer-readable medium of claim 32, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object." (emphasis added).

For example, the Appellants' invention teaches target object bit rate, V_i, is determined for each object i (i= 1, 2, 3...) as follows:

$$V_i = K_i \times T_{frame}, \qquad \text{where } K_i = \frac{(Mad_i)^2}{\sum_{k=i}^{n}(Mad_k)^2}, \text{ and}$$

where Mad_i is the mean absolute difference (MAD) of an object i, n is the number of objects in a frame, and V_i is the estimated target object bit rate for object i. Namely, a computation is performed on the entire region or regions that define an "object" in the image to obtain an average pixel value for the object.

More specifically, the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object. Next, the sum of all the absolute differences (SAD) of the pixels for the object is performed. Finally, the SAD is divided by the number of pixels in the object to produce a mean of the absolute difference pixel values (MAD) for the object. Thus, the target frame bits T_{frame} are distributed proportional to the square mean of the absolute differences (MAD) of an object.

For example, if Mad_a for an object "a" is 2 and Mad_b for an object "b" is 3, and T_{frame} is determined to be 100, then V_a and V_b are given respectively as:

$$V_a = \frac{2^2}{2^2+3^2} \times 100 \text{ and } V_b = \frac{3^2}{2^2+3^2} \times 100$$ (see Appellants' specification, page 13, lines 5-33).

The Eleftheriadis reference is completely silent with regard to the target object bit rate for the at least one object being selected in accordance with a <u>mean absolute differences</u> (Mad) of said object. Rather, The Eleftheriadis reference merely discloses that the total average rate R is equal to the sum of the proportion of pixels in the frame that belong to each object i. Specifically, equation (4) of Eleftheriadis discloses that $\sum_{i=0}^{n} a_i R_i = R$, where a_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i. Nowhere in the Eleftheriadis reference is there any teaching that the <u>mean absolute differences</u> (Mad) of the object is derived by computing <u>the absolute difference between each pixel value</u> (in the original image) and the corresponding pixel

value (in the predicted image) is performed for pixels defined within the object, and then determining the mean absolute difference from such absolute differences between each pixel value in the original image and the corresponding predicted image. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims, since the Eleftheriadis reference fails to teach "wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object."

As such, the Appellants submit that dependent claims 23 and 33 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 23 recites the present invention as a general method, whereas claim 33 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

C. 35 U.S.C. §102 – Claims 24 and 34

The Examiner has rejected claims 24 and 34 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claims 24 and 34 respectively depend from independent claims 22 and 32, and recite additional features thereof. The Eleftheriadis reference fails to teach claims 22 and 32 of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims. As such, Appellants respectfully submit that dependent claims 24 and 34 are also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that Eleftheriadis discloses:

> "the object bit rate is adjusted depending on buffer fullness."

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "wherein said target object bit rate is adjusted in accordance with a measure of a buffer fullness." Specifically, Appellants' claims 24 and 34 recite:

> 24. "The method of claim 22, wherein said target object bit rate is adjusted in accordance with a measure of a buffer fullness." (emphasis added).
>
> 34. " The computer-readable medium of claim 32, wherein said target object bit rate is adjusted in accordance with a measure of a buffer fullness." (emphasis added).

The Appellants' invention teaches target object bit rate, V_i, is adjusted at step 430, of method 400 in accordance with equations (8a-b), which are expressed as:

$$\begin{aligned}&if\,(buffer\_fullness + V_i \rangle margin) \text{ then}\\ &\mathrm{V_i} = Max(R_s / 30 / number\_of\_objects,\ margin - buffer\_fullness)\end{aligned} \quad (8a)$$

$$\begin{aligned}&if\,(buffer\_fullness - B_{pp} + V_i \le SAFETY\_MARGIN \times buffer\_size) \text{ then}\\ &\mathrm{V_i} = B_{pp} - V_i - buffer\_fullness + SAFETY\_MARGIN \times buffer\_size.\end{aligned} \quad (8b);$$

where "margin" is defined as:

$$margin = ceil((1.0 - SAFETY\_MARGIN) \times buffer\_fullness) \qquad (9);\text{ and}$$

where "buffer_fullness" is the current buffer fullness (i.e., the portion of the buffer that contains bits to be sent to the decoder), "SAFTETY_MARGIN" is a constant set at 0.1 (other values can be used depending on the application), R_s is a bit rate for the sequence (or segment), "number_of_objects" is the number of objects in the image, "buffer_size" is the size of the buffer, and B_{pp} is the channel output rate. Namely, if method 400 detects the buffer condition defined by equation (8a), then V_i is adjusted lower to a value that is the greater of the bit_rate divided by 30 (a display frame rate for video) divided by the number of objects in the image or the remainder of the space in the buffer, less a portion defined by "margin", i.e., margin-buffer_fullness.

Alternatively, if method 400 detects the buffer condition defined by equation (8b), V_i is adjusted to account for the channel output rate. In sum, V_i is adjusted in accordance with the current state of the buffer, i.e., the fullness of the buffer. At this

step, method 400 has completed the task of computing a target object bit rate V_i for each object in the image.

Once V_i for each object in the image is determined, the target object bit rate V_i can be used to affect other coding parameters such as determining a quantizer scale for each object as discussed below. Alternatively, other coding parameters such as allocation of computing resources can be implemented. Namely, if it is determined that a particular object has a high V_i, then it is possible to allocate more processing power, e.g., dedicating more processors in a multiple processors coding system in coding a particular object (see Appellants' specification, page 16 line 25 to page 17 line 26).

The Eleftheriadis reference is completely silent with regard to the target object bit rate being adjusted in accordance with a measure of a buffer fullness. Rather, The Eleftheriadis reference merely discloses target average bit rates R_i, which are used in a buffer regulation process that uses a technique of buffer rate and buffer size modulation (see, Eleftheriadis, column 12, lines 40-42). Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "said target object bit rate is adjusted in accordance with a measure of a buffer fullness."

As such, the Appellants submit that dependent claims 24 and 34 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 24 recites the present invention as a general method, whereas claim 34 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

D. 35 U.S.C. §102 – Claims 25 and 35

The Examiner has rejected claims 25 and 35 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claims 25 and 35 respectively depend from independent claims 22 and 32, and recite additional features thereof. The Eleftheriadis fails to teach claims 22 and 32

of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims. As such, Appellants respectfully submit that dependent claims 25 and 35 are also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that Eleftheriadis discloses:

> "using shape information for both field or frame compression, as well as object-based compression, syntax information, and shape information are all inherent part of object-based compression."

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object."

Specifically, Appellants' claims 25 and 35 recite:

> 25. "The method of claim 22, wherein said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object." (emphasis added).
>
> 35. " The computer-readable medium of claim 32, wherein said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object." (emphasis added).

The Appellants' invention teaches that to avoid the situation where a significant portion of the target object bits are dedicated toward encoding the motion vectors, and/or the object shape information, instead of spending the available bits to code the object context or texture, method 400 employs an object shape control mechanism (a threshold called "$alpha\_th_i$") to incrementally or decrementally change the number of bits allocated for shape coding.

More specifically, if the query at step 420 is answered negatively, then method 400 proceeds to step 423, where threshold $alpha\_th_i$ is adjusted in accordance with:

$$if\ (V_i \leq syntax_i + motion_i + shape_i)\ \text{then} \qquad (6)$$
$$alpha\_th_i = \min(35,\ alpha\_th_i + d)$$

where $syntax_i$ represents bits necessary to code syntax information (e.g., header information) for object i; $motion_i$ represents bits necessary to code motion information (e.g., motion vectors) for object i; $shape_i$ represents bits necessary to code shape information for object i; and "d" is a constant set to a value of five (5). The constant "d" can be set to other values depending on the specific application.

Initially, the threshold, $alpha\_th_i$, is set to zero for an object i, but once $alpha\_th_i$ is established for an object, it is then passed (and possibly modified) from frame to frame. It should be noted that $shape_i$ in equation (6) is initially taken from the corresponding $shape_i$ in the previous frame. This allows method 400 to quickly gauge whether V_i is sufficient to code $syntax_i$, $motion_i$ and $shape_i$, thereby controlling how $alpha\_th_i$ is to be adjusted (see Appellants' specification, page 14 line 8 to page 15 line 13).

The Eleftheriadis reference merely discloses that the Eleftheriadis invention utilizes shape information in the video compression process, both in the case of field or frame based compression techniques and in the case of object-based compression techniques. Further, global motion vectors, which represent the motion or displacement of the object as a whole from one frame to another, are generated by correlating the object's position vectors of the previous and present frames (see Eleftheriadis, column 2, lines 13-36, and column 3, lines 26-30). However, nowhere is there any teaching that the <u>target object bit rate</u> is allocated to code <u>a syntax information</u>, a motion information, and a shape information of the object.

Further, the Examiner contends that syntax information, motion information, and shape information are all inherent part of object-based compression. The Appellants respectfully disagree. Specifically, it is not inherent that the <u>target object bit rate</u> is allocated to code motion information. For example, a motion vector in an object may be derived from motion vectors of other objects in predictive frames. That is, in an instance where motion information of an object is absent, motion information for such target may still be derived from extrapolating motion information from other objects, including background information and secondary objects in subsequent and previous frames. Accordingly, it is <u>not</u> inherent (i.e., necessary) that the target object bit rate is allocated

to code motion information. Rather, such information may be derived from other targets in the frame. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "wherein said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object."

As such, the Appellants submit that dependent claims 25 and 35 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 25 recites the present invention as a general method, whereas claim 35 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

E. 35 U.S.C. §102 – Claims 26 and 36

The Examiner has rejected claims 26 and 36 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claims 26 and 36 respectively depend indirectly from independent claims 22 and 32, and recite additional features thereof. The Eleftheriadis fails to teach claims 22 and 32 of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims. As such, Appellants respectfully submit that dependent claims 26 and 36 are also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that at column 19, lines 23-35 Eleftheriadis discloses:

> "other rate control techniques which assign different bit rates to objects based on shape or depth information."

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "wherein the bit allocation to the shape information of an object is adjusted." Specifically, Appellants' claims 26 and 36 recite:

> 26. "The method of claim 25, wherein said bit allocation to said shape information of an object is adjusted." (emphasis added).
>
> 36. " The computer-readable medium of claim 35, wherein said bit allocation to said shape information of an object is adjusted." (emphasis added).

The Appellants' invention teaches that to avoid the situation where a significant portion of the target object bits are dedicated toward encoding the motion vectors, and/or the object shape information instead of spending the available bits to code the object context or texture, method 400 employs an object shape control mechanism (a threshold called "alpha_th$_i$") to incrementally or decrementally change the number of bits allocated for shape coding.

More specifically, if the query at step 420 is answered negatively, then method 400 proceeds to step 423, where threshold alpha_th$_i$ is adjusted in accordance with:

$$\begin{aligned} &\textit{if } (V_i \le syntax_i + motion_i + shape_i) \text{ then} \\ &alpha\_th_i = \min(35,\ alpha\_th_i + d) \end{aligned} \tag{6}$$

where syntax$_i$ represents bits necessary to code syntax information (e.g., header information) for object i; motion$_i$ represents bits necessary to code motion information (e.g., motion vectors) for object i; shape$_i$ represents bits necessary to code shape information for object i; and "d" is a constant set to a value of five (5). The constant "d" can be set to other values depending on the specific application.

Initially, the threshold, alpha_th$_i$, is set to zero for an object i, but once alpha_th$_i$ is established for an object, it is then passed (and possibly modified) from frame to frame. It should be noted that shape$_i$ in equation (6) is initially taken from the corresponding shape$_i$ in the previous frame. This allows method 400 to quickly gauge whether V_i is sufficient to code syntax$_i$, motion$_i$ and shape$_i$, thereby controlling how alpha_th$_i$ is to be adjusted (see Appellants' specification page 14 line 21 to page 15 line 21).

The Eleftheriadis reference is completely silent with regard to the Appellants'

feature "wherein said bit allocation to said shape information of an object is adjusted." Rather, Eleftheriadis merely discloses that more sophisticated rate control techniques may be used, such as a system that may try to identify the semantics of the different objects (e.g., human faces, sheets of paper, etc) and automatically assign appropriate bit rates or quality levels to them (see Eleftheriadis, column 19, lines 26-35).

However, nowhere does Eleftheriadis teach that the assigned bit rates are allocated to the shape information of an object. That is, the target object bit rate is first allocated to code syntax information, motion information, and shape information bit rates of the object (claims 25 and 35), and further provides (in claims 26 and 36) that the bit allocation to the shape information may be adjusted. Such teachings of the Appellants' invention are simply not taught by Eleftheriadis. Rather, Eleftheriadis generally discloses that bit rates will be adjusted if a particular object is identified by semantics. That is, there is no teaching that the adjustment to the bit rates are allocated to the shape information of the object. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "wherein said bit allocation to said shape information of an object is adjusted."

As such, the Appellants submit that dependent claims 26 and 36 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 26 recites the present invention as a general method, whereas claim 36 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

F. 35 U.S.C. §102 – Claims 27 and 37

The Examiner has rejected claims 27 and 37 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claims 27 and 37 respectively depend from independent claims 22 and 32, and recite additional features thereof. The Eleftheriadis fails to teach claims 22 and 32

of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims. As such, Appellants respectfully submit that dependent claims 27 and 37 are also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that at column 10, lines 34-54, Eleftheriadis discloses:

> "quantization being dependent on a specific object and its attributes, i.e., bit rate."

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object." Specifically, Appellants' claims 27 and 37 recite:

> 27. "The method of claim 22, further comprising the step of:
>
> (c) generating a quantizer scale for said at least one object in accordance with said target object bit rate." (emphasis added).
>
> 37. "The computer-readable medium of claim 32, further comprising the step of:
>
> (c) generating a quantizer scale for said at least one object in accordance with said target object bit rate." (emphasis added).

The Appellants' invention teaches that the rate control module 130 selects a quantizer scale for each region or "object" within each frame to maintain the overall quality of the video image while controlling the coding rate. Namely, a frame can be evaluated to determine if certain regions within the frame require more or less bit rate allocation. It has been observed that for different applications, various regions are of more interest than other regions, e.g., the face of a person in a video phone application is more important to a human viewer than the background in general. Other examples

include medical applications, where certain regions of an image, i.e., a potential tumor is more important than the surrounding tissues or in surveillance applications, where certain regions of an image, i.e., a military assess is more important than the surrounding camouflage, and so on. Thus, the particular application will dictate the criteria that define the importance of relevant regions or objects within a frame. In the present invention, a quantizer scale is selected for each region or object within each frame such that target bit rate for the picture is achieved while maintaining a uniform visual quality over the entire sequence of pictures (see Appellants' specification, page 8 lines 9-27).

By contrast, the Eleftheriadis reference discloses generating an "object map" i.e., an association of each pixel with a particular object, where the object map is provided to the rate control circuit 440 so that quantization decisions for the current frame can be made (see Eleftheriadis, column 10 lines 34-48). However, the Eleftheriadis reference fails to teach that a quantizer scale is generated for an object in accordance with the target object bit rate. As discussed above with respect to the rejection of independent claims 22 and 32, the Eleftheriadis reference discloses a particular target average bit rate R_i, without further defining what constitutes a target average bit rate. That is, Eleftheriadis is completely silent regarding an average bit rate. By contrast, the Appellants have defined a target object bit rate V_i as a mean of the absolute difference pixel values (MAD) for the object. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "generating a quantizer scale for said at least one object in accordance with said target object bit rate."

As such, the Appellants submit that dependent claims 27 and 37 are not anticipated and fully satisfy the requirements under 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 27 recites the present invention as a general method, whereas claim 37 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

G. 35 U.S.C. §102 – Claims 28 and 38

The Examiner has rejected claims 28 and 38 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

Claims 28 and 38 respectively depend from independent claims 22 and 32, and recite additional features thereof. In particular, claims 28 and 38 recite in part:

> 28. "The method of claim 27, further comprising the step of: (d) encoding said at least one object with said quantizer scale." (emphasis added).
>
> 38. "The computer-readable medium of claim 37, further comprising the step of: (d) encoding said at least one object with said quantizer scale." (emphasis added).

The Eleftheriadis fails to teach claims 28 and 38 of Appellants' invention, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame" and "allocating said target frame bit rate in accordance with a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claims.

As such, Appellants respectfully submit that dependent claims 28 and 38 are not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder. Furthermore, Appellants assert that these claims are different to the extent that claim 28 recites the present invention as a general method, whereas claim 38 recites the present invention as embodied in a computer readable medium. Therefore, the Appellants respectfully request that the rejections of these claims be reversed.

H. 35 U.S.C. §103 – Claim 29

The Examiner has rejected claim 29 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, the Examiner alleges that Eleftheriadis discloses:

Objects associated with, assigned, or allocated a target object bit rate, based on a target frame bit rate. Specifically, R is the frame bit rate or target bit rate, R_i is a target average bit rate for each object, a_i is the amount of the total frame rate R that is allocated to the object while R_n is the amount of the total frame rate R that is allocated to the background.

The Examiner further alleges that the allocation target frame bit rate, in accordance to a target object bit rate, for a at least one object, is also disclosed in Column 12, Equation 4 (i.e., $\sum_{i=0}^{n} a_i R_i = R$). As can be seen, part of the target frame bit rate is allocated or distributed as target object bit rate, while the remainder is allocated or distributed as background target bit rate, the sum of the two being equal to R (target frame bit rate).

Column 15, lines 19-35 disclose multiple functions of Eleftheriadis' invention being implemented through software and hardware, which is equivalent to instructions being stored on a computer readable medium for carrying out method of claim 22. In addition, this section also teaches that the target object bit rate is adjusted depending on buffer fullness.

Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "determining <u>a target</u> frame bit rate for the frame" and "allocating said <u>target</u> frame bit rate among the at least one object, wherein said allocating step comprises the step of allocating said <u>target</u> frame bit rate in accordance with a target object bit rate for the at least one object." Specifically, Appellants' independent claim 29 recites:

29. "Apparatus for encoding each frame of an image sequence, said frame having at least one object, said apparatus comprising:

a motion compensator for generating a predicted image of a current frame;

a transform module for applying a transformation to a difference signal between the current frame and said predicted image, where said transformation produces a plurality of coefficients;

a quantizer for quantizing said plurality of coefficients with at least one quantizer scale; and

a controller for selectively adjusting said at least one quantizer scale for a current frame in response to <u>a target object bit rate</u> for the at least one object." (emphasis added).

The Appellants' invention teaches an apparatus for encoding each frame of an image sequence, where each of frame has at least one object. Namely, Appellants'

invention teaches a controller for selectively adjusting the at least one quantizer scale for a current frame in response to a target object bit rate for the at least one object.

Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim" (Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added). The Eleftheriadis reference fails to disclose each and every element of the claimed invention, as arranged in the claim.

By contrast, Eleftheriadis discloses a method and apparatus for performing image compression and segmentation by using 3-D depth information. Namely, Eleftheriadis' device is able to exploit depth information to assist in the compression and segmentation of images. (See Eleftheriadis, Abstract).

In particular, the Eleftheriadis reference merely discloses "in accordance with that technique, each object is associated with a particular target average bit rate R_i, i=1, . . . , n-1, except for the background (object n). In order to maintain the given total average rate R necessary to prevent buffer overflow, the **background rate** is determined according to the formula:

$\sum_{i=0}^{n}\alpha_i R_i = R$ where α_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i." (Emphasis added, See, Eleftheriadis, Column 11, line 67 to Column 12, line 10)

Thus, Eleftheriadis is simply disclosing an allocation approach where the average rate R necessary to prevent buffer overflow is used to compute the **background rate**.

Eleftheriadis also defines "R is the average output bit rate to be maintained by the buffer 1020". (See Eleftheriadis, Column 13, lines 31-32). In other words, R represents a measure of the physical buffer "fullness" and it is **not** a "target frame bit rate" as claimed by the Appellants. Namely, Eleftheriadis' teaching of using the average output bit rate of a physical buffer to compute a background rate would not anticipate Appellants' invention that recites the novel concept of computing a **target** object bit rate for each object and then allocating a target frame bit rate among the objects in accordance with their computed target object bit rates.

Another clear indication is that Eleftheriadis states that "referring again to FIG. 10, the rates R_i are used in a buffer regulation process that uses a technique of buffer rate and buffer size modulation" (See Eleftheriadis, Column 12, lines 40-42). It is absolutely clear that the object rate of Eleftheriadis is premised on the buffer fullness and not based on a target frame rate.

In the Final Office Action, the Examiner reasoned that "any bit rate utilized to maintain buffer fullness, and prevent underflow can be considered a target bit rate as claimed by the Appellants". Appellants respectfully disagree.

Appellants specifically recite "a target **frame** bit rate" and not a general "target bit rate" as alleged by the Examiner. Generally, the buffer fullness is intended to operate with a transmission channel with a constant transmission rate. Thus, it is generally necessary to monitor the fullness of the buffer to avoid overflow and underflow conditions. Aside from this general understanding, it is improper to then simply extrapolate the teaching of the buffer fullness to the determination of a target frame bit rate. For example, if the buffer is too full, the encoder may simply drop a frame, change the coding mode of a frame, change the frame type, change the quantizer scale of a frame, change the quantizer scale of a slice, change the quantizer scale of a macroblock, change the block size, and so on. None of these possible solutions requires the determination of a target frame bit rate. The number of possible solutions is endless in responding to buffer fullness conditions and involves numerous image processing fields. Is the Examiner indicating that Eleftheriadis' simple teaching of monitoring buffer fullness now anticipates all possible inventions relating to rate control, motion estimation, motion compensation, mode decision, frame type selection, block size selection and so on. The Examiner's interpretation is simply too broad.

Accordingly, the Appellants submit that R, as defined by Eleftheriadis, can not be interpreted to be a target frame rate as positively claimed by the Appellants. There is simply no support in Eleftheriadis for this interpretation. Additionally, Appellants claim a **target** frame bit rate. Namely, Appellants' invention computes a specific bit budget for each frame.

In one embodiment, the Appellants have defined a **target** frame bit rate as being determined based on the bits available and the last encoded frame bits. If the last

frame is complex and uses many bits, it leads to the premise that more bits should be assigned to the current frame. However, this increased allocation will diminish the available number of bits for encoding the remaining frames, thereby limiting the increased allocation to this frame. Accordingly, a weighted average reflects a compromise of these two factors, and the non-weighted target frame bit rate adjusted by the current buffer fullness (see Appellants' specification, page 11, lines 19-30).

Thus, the Appellants' target frame bit rate is clearly different from the Eleftheriadis reference teachings of a total average rate R. Thus, the Eleftheriadis reference is concerned with a total average rate R for the objects R_i, while the Appellants' invention provides a target frame bit rate, which is based on the bits available and the last encoded frame bits. Therefore, the Eleftheriadis reference fails to teach each and every element in the claimed invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "determining a target frame bit rate for the frame."

Furthermore, the Eleftheriadis reference fails to teach a target object bit rate V_i. In particular, the Appellants' invention provides that the target object bit rate V_i is determined for each object i (i= 1,2, ...), where a computation is performed on the entire region or regions that define an "object" in the image to obtain an average pixel value for the object. More specifically, the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object. Next, the sum of all the absolute differences (SAD) of the pixels for the object is performed. Finally, the SAD is divided by the number of pixels in the object to produce a mean of the absolute difference pixel values (MAD) for the object. Thus, the target frame bits T_{frame} are distributed proportional to the square mean of the absolute differences (MAD) of an object (see Appellants' specification, page 13 lines 5-26).

By contrast, the Eleftheriadis reference discloses a particular target average bit rate R_i, without further defining what constitutes a target average bit rate. That is, Eleftheriadis is completely silent regarding this matter. By contrast, the Appellants have defined a target object bit rate V_i as a mean of the absolute difference pixel values

(MAD) for the object. Therefore, the Eleftheriadis reference fails to teach each and every element in the claimed invention, as arranged in the claim.

As such, the Appellants submit that independent claim 29 is not anticipated and fully satisfies the requirements under 35 U.S.C. §102 and is patentable thereunder. Therefore, the Appellants respectfully request that the rejection of this claim be reversed.

I. 35 U.S.C. §103 – Claims 30

The Examiner has rejected claim 30 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejections are respectfully traversed.

First, claim 30 depends from independent claim 29 and recites additional features thereof. The Eleftheriadis fails to teach claim 29 of Appellants' invention, since the Eleftheriadis reference fails to teach "a controller for selectively adjusting said at least one quantizer scale for a current frame in response to a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim. As such, Appellants respectfully submit that dependent claim 30 is also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfies the requirements of 35 U.S.C. §102 and is patentable thereunder.

Second, the Examiner alleges that Eleftheriadis discloses:

> "the use of the sum of the absolute differences between tow VOP to obtain shape information, and further control the rate at which object information is processed. The mean absolute difference is an inherent manipulation of data obtained through the summing of the absolute differences."

The Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' " wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object." Specifically, Appellants' claim 30 recites:

30. "The method of claim 29, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object." (emphasis added).

For example, the Appellants' invention teaches target object bit rate, V_i, is determined for each object i (i= 1, 2, 3...) as follows:

$V_i = K_i \times T_{frame}$, where $K_i = \frac{(Mad_i)^2}{\sum_{k=i}^{n}(Mad_k)^2}$, and

where Mad_i is the mean absolute difference (MAD) of an object i, n is the number of objects in a frame, and V_i is the estimated target object bit rate for object i. Namely, a computation is performed on the entire region or regions that define an "object" in the image to obtain an average pixel value for the object.

More specifically, the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object. Next, the sum of all the absolute differences (SAD) of the pixels for the object is performed. Finally, the SAD is divided by the number of pixels in the object to produce a mean of the absolute difference pixel values (MAD) for the object. Thus, the target frame bits T_{frame} are distributed proportional to the square mean of the absolute differences (MAD) of an object.

For example, if Mad_a for an object "a" is 2 and Mad_b for an object "b" is 3, and T_{frame} is determined to be 100, then V_a and V_b are given respectively as:

$V_a = \frac{2^2}{2^2+3^2} \times 100$ and $V_b = \frac{3^2}{2^2+3^2} \times 100$ (see Appellants' specification, page 13, lines 5-33).

The Eleftheriadis reference is completely silent with regard to the target object bit rate for the at least one object being selected in accordance with a mean absolute differences (Mad) of said object. Rather, The Eleftheriadis reference merely discloses that the total average rate R is equal to the sum of the proportion of pixels in the frame that belong to each object i. Specifically, equation (4) of Eleftheriadis discloses that $\sum_{i=0}^{n} a_i R_i = R$, where a_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that

belong to object i. Nowhere in the Eleftheriadis reference is there any teaching that the mean absolute differences (Mad) of the object is derived by computing the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object, and then determining the mean absolute difference from such absolute differences between each pixel value in the original image and the corresponding predicted image. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object."

As such, the Appellants respectfully submit that claim 30 is not obvious and fully satisfies the requirements of 35 U.S.C. §103 and is patentable thereunder. Therefore, the Appellants respectfully request that the rejection of this claim be reversed.

J. 35 U.S.C. §103 – Claim 31

The Examiner has rejected claim 31 in paragraph 4 of the Final Office Action as being anticipated under 35 U.S.C. §102 by the Eleftheriadis et al. patent (United States Patent No. 6,055,330, issued April 25, 2000, hereinafter "Eleftheriadis"). The rejection is respectfully traversed.

First, claim 31 depends from independent claim 29 and recites additional features thereof. The Eleftheriadis fails to teach or suggest claim 29 of Appellants' invention, since the Eleftheriadis reference fails to teach "a controller for selectively adjusting said at least one quantizer scale for a current frame in response to a target object bit rate for the at least one object." Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim. As such, Appellants respectfully submit that dependent claim 31 is also not anticipated by the teachings of Eleftheriadis and, as such, fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

Second, the Examiner alleges that column 12, Equation (4) of Eleftheriadis discloses:

"part of the target frame bit rate is allocated or distributed as target object bit rate, while the remainder is allocated or distributed as background target bit rate, the sum of the two being equal to R (target frame bit rate)."

The Appellants respectfully disagree with the Examiner's reading of the cited reference. The Board's attention is directed to the fact that Eleftheriadis fails to teach Appellants' "wherein said target object bit rate is derived from a target frame bit rate." Specifically, Appellants' claim 31 recites:

31. "The method of claim 29, wherein said <u>target object bit rate</u> is derived from a <u>target frame bit rate</u>." (emphasis added).

The Appellants' invention teaches target object bit rate, V_i, is determined for each object i (i= 1, 2, 3...) as follows:

$$V_i = K_i \times T_{frame}, \qquad \text{where } K_i = \frac{(Mad_i)^2}{\sum_{k=i}^{n}(Mad_k)^2}, \text{ and}$$

where Mad_i is the mean absolute difference (MAD) of an object i, n is the number of objects in a frame, and V_i is the estimated target object bit rate for object i. Namely, a computation is performed on the entire region or regions that define an "object" in the image to obtain an average pixel value for the object.

More specifically, the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object. Next, the sum of all the absolute differences (SAD) of the pixels for the object is performed. Finally, the SAD is divided by the number of pixels in the object to produce a mean of the absolute difference pixel values (MAD) for the object. Thus, the target frame bits T_{frame} are distributed proportional to the square mean of the absolute differences (MAD) of an object.

For example, if Mad_a for an object "a" is 2 and Mad_b for an object "b" is 3, and T_{frame} is determined to be 100, then V_a and V_b are given respectively as:

$$V_a = \frac{2^2}{2^2+3^2} \times 100 \text{ and } V_b = \frac{3^2}{2^2+3^2} \times 100$$

(see Appellants' specification, page 13, lines 5-33).

The Eleftheriadis reference is completely silent with regard to the target object

bit rate for the at least one object being selected in accordance with a mean absolute differences (Mad) of said object. Rather, The Eleftheriadis reference merely discloses that the total average rate R is equal to the sum of the proportion of pixels in the frame that belong to each object i. Specifically, equation (4) of Eleftheriadis discloses that $\sum_{i=0}^{n} a_i R_i = R$, where a_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i. Nowhere in the Eleftheriadis reference is there any teaching that the mean absolute differences (Mad) of the object is derived by computing the absolute difference between each pixel value (in the original image) and the corresponding pixel value (in the predicted image) is performed for pixels defined within the object, and then determining the mean absolute difference from such absolute differences between each pixel value in the original image and the corresponding predicted image. Therefore, the Eleftheriadis reference fails to teach each and every element of the Appellants' invention, as arranged in the claim, since the Eleftheriadis reference fails to teach "wherein said target object bit rate is derived from a target frame bit rate."

As such, the Appellants respectfully submit that claim 31 is not obvious and fully satisfies the requirements of 35 U.S.C. §103 and is patentable thereunder. Therefore, the Appellants respectfully request that the rejection of this claim be reversed.

Conclusion

For the reasons advanced above, Appellants respectfully urge that the rejections of claims 22-30 and 32-38 as being unpatentable under 35 U.S.C. §102 are improper. Reversal of the rejections in this appeal is respectfully requested.

Respectfully submitted,

12/8/03

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APPENDIX – Pending Claims

1-21. Cancelled

22. (Previously Presented) A method for allocating bits to encode each frame of an image sequence, each of said frame having at least one object, said method comprising the steps of:

(a) determining a target frame bit rate for the frame; and

(b) allocating said target frame bit rate among the at least one object, wherein said allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object.

23. (Previously Presented) The method of claim 22, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object.

24. (Previously Presented) The method of claim 22, wherein said target object bit rate is adjusted in accordance with a measure of a buffer fullness.

25. (Previously Presented) The method of claim 22, wherein said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object.

26. (Previously Presented) The method of claim 25, wherein said bit allocation to said shape information of an object is adjusted.

27. (Previously Presented) The method of claim 22, further comprising the step of:

(c) generating a quantizer scale for said at least one object in accordance with said target object bit rate.

28. (Previously Presented) The method of claim 27, further comprising the step of:

(d) encoding said at least one object with said quantizer scale.

29. (Previously Presented) Apparatus for encoding each frame of an image sequence, said frame having at least one object, said apparatus comprising:

a motion compensator for generating a predicted image of a current frame;

a transform module for applying a transformation to a difference signal between the current frame and said predicted image, where said transformation produces a plurality of coefficients;

a quantizer for quantizing said plurality of coefficients with at least one quantizer scale; and

a controller for selectively adjusting said at least one quantizer scale for a current frame in response to a target object bit rate for the at least one object, wherein said target object bit rate is derived from a target frame bit rate.

30. (Previously Presented) The apparatus of claim 29, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object.

31. Cancelled.

32. (Previously Presented) A computer-readable medium having stored thereon a plurality of instructions, the plurality of instructions including instructions which, when executed by a processor, cause the processor to perform the steps comprising of:

(a) determining a target frame bit rate for the frame; and

(b) allocating said target frame bit rate among the at least one object,_wherein said allocating step comprises the step of allocating said target frame bit rate in accordance with a target object bit rate for the at least one object.

33. (Previously Presented) The computer-readable medium of claim 32, wherein said target object bit rate for the at least one object is selected in accordance with a mean absolute differences (Mad) of said object.

34. (Previously Presented) The computer-readable medium of claim 32, wherein said target object bit rate is adjusted in accordance with a measure of a buffer fullness.

35. (Previously Presented) The computer-readable medium of claim 32, wherein said target object bit rate is allocated to code a syntax information, a motion information, and a shape information of the object.

36. (Previously Presented) The computer-readable medium of claim 35, wherein said bit allocation to said shape information of an object is adjusted.

37. (Previously Presented) The computer-readable medium of claim 32, further comprising the step of:

(c) generating a quantizer scale for said at least one object in accordance with said target object bit rate.

38. (Previously Presented) The computer-readable medium of claim 37, further comprising the step of:

(d) encoding said at least one object with said quantizer scale.